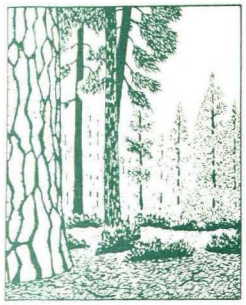

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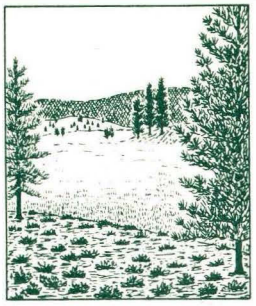

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CHEMICAL FIRE RETARDANTS FOR WILD LAND FIRE CONTROL

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Tests conducted in 1955 suggest that chemical fire retardants can open up a new era in forest-fire control. Retardants were successfully used to hold the flanks, rear, and cooler parts of the head of wildfires in brush and grass and for rapid construction of backfire lines. Aerial delivery of retardants was shown to be feasible.1/

Several chemicals had shown promise for wild land fire control during Operation Firestop in 1954. Since only plot tests were used in Firestop, however, the practicability of using chemical retardants on going wild fires needed testing before research to develop the most effective methods and formulations was undertaken. Consequently, a cooperative research study was established to meet the following objectives:

1. To test the feasibility of using chemicals in wild land fire control under full-scale field conditions.

2. To gain information on the problems involved in the use of chemicals on fires.

Cooperators with the California Forest and Range Experiment Station in the field program were the California Division of Forestry, the Los Angeles County Fire Department, and the Pacific Coast Borax Company.

1/ Ely, Joseph B., and Jensen, Arthur W., Air delivery of water helps control brush and grass fires. California Forest and Range Experiment Station Forest Research Note 99, 12 pp., illus. 1955.

Test Procedure

Sodium calcium borate was the retardant selected for use in this study. This substance is representative of the group of chemicals which retard fire spread by their insulating qualities as well as chemical action. Sodium calcium borate is an ore mined and processed on the West Coast. The chemical is non-toxic to human beings and livestock. It is slightly corrosive to zinc and brass but is not corrosive to iron. Such borate compounds may be used as soil sterilants and herbicides when applied at the rate of 10 to 15 pounds per 100 square feet of surface area. Less than 2 percent of the material is soluble in water; but when finely ground, it can easily be put into a stable suspension at concentrations up to 8 pounds per gallon of water. Besides a high melting point (1,000° C.), the chemical has other properties particularly desirable in a fire retardant to be applied in spray form. It covers well and adheres well to vegetation.

Standard pumper tankers were modified slightly for these field tests. Openings were made in the top plate of the tank so that dry chemical could be poured easily into the water. Agitation for mixing was obtained by leading a by-pass pipe from the pump back to the bottom of the tank.

Before each unit was put into operation, its crew was oriented by personnel from the Pacific Coast Borax Company and the Experiment Station. Proper mixing and possible methods of application were demonstrated. One member of each tank truck crew was trained to observe the effect of the chemical on fire and to record the information necessary for evaluating results. Crew foremen designated the method of application on each fire. In order to encourage exploration of different uses and techniques, precise procedures or limitations were not established.

Use and Results

In spite of the severe 1955 fire season in California, the test units had only a few opportunities to use chemicals. Nevertheless, results were encouraging.

Wild land fires. --Approximately 5,800 feet of fire lines, 4 to 6 feet wide, were pretreated (sprayed in advance of the fire) through grass and light to medium-heavy brush to hold the flanks, rear, and head of fires. The fuel was coated with retardant applied as a fine

spray at about 3 gallons per 100 square feet, 5 to 30 minutes before it was reached by fire. This chemical line held except for one small section in grass which burned through at the head of a fire.

Controlled burning.--On a moderate slope 1,600 feet of line, 6 to 8 feet wide was treated through grass and light to medium-heavy brush across the head and on the flanks of the fire. The retardant was applied to the fuel as a fine spray at 3.5 gallons per 100 square feet and allowed to dry 3 to 4 hours before the area was fired. The flanks and cooler parts of the fire head were contained by the chemical line. Hot parts of the fire head burned through the line. Experienced observers reported that these same fire heads probably would have swept across cleared fire breaks of the same width.

Spot fires.--A serious source of spot fires in the oak-woodland type was reduced by pretreating scrub oaks inside the fire line. Surface fuels at the base of trees and about 4 feet of the lower part of each crown were sprayed with retardant. The chemically pretreated scrub oak did not ignite and "crown-out", whereas untreated trees burned readily.

Backfiring lines.--The use of a chemical retardant for rapid construction of backfiring lines showed excellent possibilities as a fire tool. Crews moved through light brush and grass at a fast walk, applying retardant on 2-to 4-foot strips. Backfiring was successfully done from these lines 0 to 20 minutes later.

Direct attack.--The chemical was applied as a spray directly on burning light brush and grass fuels along 1,500 feet of fire edge. It appeared to be as effective as water in cooling down and extinguishing the fire. Fewer re-ignitions were observed than would normally occur when water was used under the same conditions.

Equipment.--A Bean spray gun proved most suitable for applying the chemical directly to burning fuels. An overshot or basement applicator (in common use by city fire departments) equipped with a shut-off valve and a spray tip was used for pretreatment of fuels. This applicator, 5 feet long with a 30 degree bend about 10 inches from the tip, was excellent for spraying tall or dense brush.

Measurements on a Berkeley 4-stage cetrifugal pump used in Amador county showed wear of .015 to .022 inches between the suction eye and wear ring of each stage, and .028 inches in the tail shaft bearing

at the discharge end of the pump. Although this amount of abrasion is large compared to that experienced with clear water, it is about the same as normally occurs with dirty irrigation water. Much of the wear probably resulted from the mixing process, which required the chemical to pass through the pump several times.

Penetration and coverage of fuels were best when the sodium calcium borate was applied at a concentration of 5 pounds per gallon of water, through a spray nozzle of 4.5 to 7.0 gallons per minute capacity, and at a pressure of about 150 pounds per square inch.

Conclusions and Recommendations

1. Chemical fire retardants have a significant advantage over water for control of brush and grass fires. Chemicals can be used effectively to stop fires or materially reduce spread whenever heat output is not too great. This means that chemicals can be used to control small spot fires and the flanks, rear, and weak heads of large fires. The chief superiority of chemical attack over water lies in the long time that chemicals remain effective. This lasting quality of retardants permits treating fuel well in advance of the fire. For example, the chemical can be sprayed in a straight line ahead of a rough irregular fire edge, whereas water has to be applied directly to the fire edge.

2. Chemical retardants appear to have much broader uses in forest-fire control than could be tested in 1955. Among potential uses which may be of major importance are aid in slash-fire control, widening existing fire breaks, and building fire line in rocky soil where bulldozers cannot be used. More intensive field testing under a wider variety of fuel and burning conditions is needed to establish the limits of potential chemical use.

3. Preliminary indications are that aerial application of fire retardants is feasible. Further development of techniques and equipment is needed to utilize the full potential of chemicals in this method of fire attack.

4. Equipment and methods to simplify and speed the mixing of chemicals with water are needed. If mixing could be done at the pump, then chemicals could be carried dry in hoppers and either water or chemical attack could be selected at will. Mixing at this point should also eliminate most abrasion in the pump.

5. In conjunction with field tests, laboratory studies are needed to determine the best formulations, concentrations, and application rates for various fire situations.